PATENT SPECIFICATION

603,261

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COMPLETE SPECIFICATION

Improvements in and relating to Dynamo-electric Machines

We, THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, a British Company having its registered office at Crown House, Aldwych, London, W.C.2, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

Our invention relates to dynamo-electric machines and particularly to machines of this type which are adapted to be used as high speed turbo alternators.

An object of our invention is to provide an improved dynamo-electric machine provided with a composite metal winding for increasing the load capacity of the machine.

Another object of our invention is to provide an improved dynamo-electric machine of the type used as a high speed turbine alternator with a special type winding for increasing the load capacity of the machine for a given size.

A further object of our invention is to provide improved windings for a dynamo-electric machine.

A dynamo-electric machine made in accordance with this invention has a stationary and a rotatable member, the winding on the rotatable member being formed of coils having slot portions of copper or copper alloy with end loops welded thereto of light weight metal or alloy of specific gravity of less than 3.5, said winding being characterized by having strips of copper connected to the end loops for forming inter-turn connections.

In the drawing, Fig. 1 is a side elevational view, partly broken away, of a turbine generator provided with an embodiment of our invention; and Fig. 2 is a perspective view of a winding embodying our invention, such as might be used in the rotatable member of the machine shown in Fig. 1.

Referring to the drawing, we have shown our invention in connection with a dynamo-electric machine adapted to be used as a high speed turbine generator. This machine is provided with a stationary member having an outer frame 1 and a laminated core member 2 provided with a stationary armature winding 3 arranged in winding slots in the core 2. Excitation is provided to this machine by a rotatable member which is mounted in suitable bearings in end shield 4 of the stationary member of the machine. This rotatable member includes a core 5 of magnetic material having winding slots 6 extending longitudinally therethrough in which an exciting winding is adapted to be arranged. In high speed machines adapted to operate at 3,000 revolutions per minute or more, the capacity of the machine for a given size may be increased by increasing the conductivty of the conductors in the exciting winding. In the past, high conductivity has been attained by using soft drawn copper as the material of which these windings are made. However, it has been found that in time certain distortions of this soft drawn copper winding is apt to occur and thereby limit the life of the rotor. It is desirable, therefore, that this type exciting winding should be made of a high conductivity material, such as a cupreous alloy having high strength in tension and compression to stand the stresses imposed on the winding by centrifugal and thermal expansive forces. The use of windings made entirely of copper or of copper alloys on these high speed machines imposes very high stresses on the end or retaining ring which hold the end turns of the coils in position, and in certain instances, these forces become so great as to require the size of the winding to be limited, thereby limiting the capacity of the machine. It is desirable, therefore, that these end loops

should be made of a relatively light weight high conductivity material, such as aluminium, thereby reducing the stresses on the retaining ring to values which can be withstood by materials available at present for these purposes. In order to attain this improved winding to increase the capacity of this type machine, we provide an exciting winding to the rotatable member which is formed of coils, each formed of a plurality of turns in which the slot portions 7 are formed of cuprous material, such as a copper alloy, having a relatively high strength in tension and compression and a relatively high conductivity, and the end loops 8 of these coils are formed of a relatively high conductivity material having a relatively light weight. These end loops are formed of a material having a specific gravity less than 3.5 and may be made of aluminium, which has a specific gravity of approximately 2.7, or magnesium, having a specific gravity of approximately 1.74, and the range of specific gravity of materials used in making these end loops is preferably a light weight high conductivity metal having a specific gravity between 1.5 and 3.0. In order to complete the windings and to make the proper connections between the end loops and the slot portions of the coils, the end loops 8 are welded to the slot portions 7, and the ends of the end loops 8 are formed with terminal elements 9 of cupreous material welded thereto which are connected to terminals on the ends of the other coils to provide a continuous winding for the machine. As shown in Fig. 2, the coils are arranged to provide a bipolar rotor, and the two sets of coils are interconnected by a strap 10 of cupreous material mechanically connected to the terminals on the two adjacent end loops 8 of the two sets of coils. The interconnecting elements between the coils are preferably mechanically connected to the cupreous terminal element 9 and are preferably formed as laminated straps 11 of cupreous material. The ends of the two sets of coils, which in Fig. 2 are the inner turn of the inner coils, are connected by conductors 12 to suitable slip rings for connecting to a source of direct current electrical power supply for suitably energizing the winding. If desired, the connections between coils may be brazed, although it is preferable that these connections should be mechanically made in order to facilitate replacement of coils should this become necessary. In this manner, the end loops 8 will be sufficiently light so as not to impose undue stresses on the retaining end rings 13 of the machine, while the intermediate slot portions 7 will have the desired strength in tension and compression to withstand the centrifugal forces imposed thereon, and will have a relatively smaller size than the end-turned portion of the coils, thereby permitting a more efficient use of the magnetic material forming the core 5 and permitting the use of a smaller diameter rotatable member to provide the same desired amount of excitation to the machine. In machines such as that illustrated in the drawing, it is desirable to provide hydrogen cooling so that the windage losses may be decreased and the cooling effects of the hydrogen on the machine will also further increase the capacity of the machine for a given size and enable the machine to operate at relatively higher efficiency.

It is already known in the art to arrange for a reduction of specific gravity or cross-section in those parts of a rotor winding which would be most affected by stresses arising from centrifugal force.

We are aware of British Specification No. 368,034, which describes a rotor winding for high speed electrical machines wherein the portion lying in the active length of the rotor consists of copper, whilst the end windings comprise a conductive material of lower specific gravity than copper, the use of aluminium for that purpose being disclosed in the specification.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A dynamo-electric machine having a stationary and a rotatable member, the winding on the rotatable member being formed of coils having slot portions of copper or copper alloy with end loops welded thereto of light weight metal or alloy of specific gravity of less than 3.5, said winding being characterized by having strips of copper connected to the end loops for forming inter-turn connections.

2. A dynamo-electric machine having a stationary and a rotatable member as claimed in Claim 1, in which the end loops are of aluminium.

3. A high speed dynamo-electric machine comprising a stationary member and a rotatable member adapted to be operated at 3,000 or more revolutions per minute, the rotatable member having a core of magnetic material with winding slots therein, the winding for the rotatable member being formed of coils having slot portions of cupreous material

arranged in the winding slots with aluminium or magnesium end loops welded thereto having terminals of cupreous material welded to the end loops, and being characterized by having strips of cupreous material connected to the cupreous terminals for forming inter-turn connections.

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[This Drawing is a reproduction of the Original on a reduced scale.]

FIG. 1.

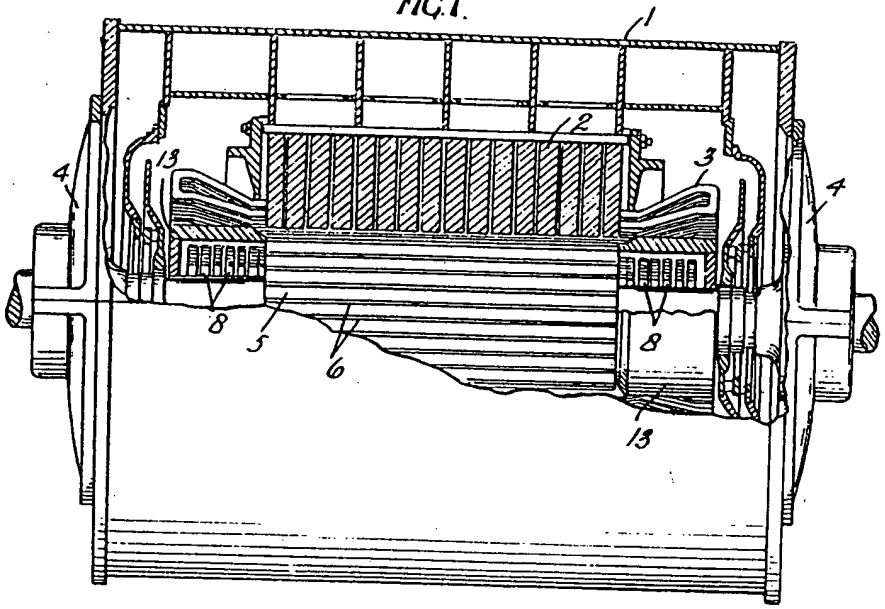
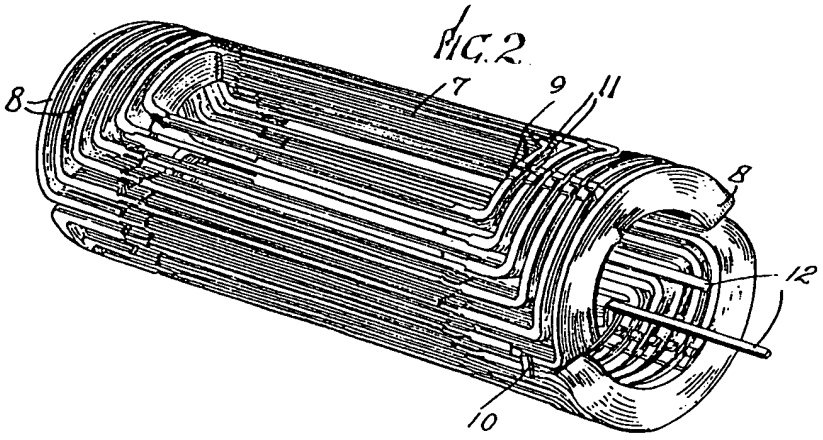


FIG. 2.



H.M.S.O. (Ty.P.)